CAPLAST

ENVIRONMENTAL PRODUCT DECLARATION

Name of product:	Site:
Air, wind, vapour and water barrier membranes for roof application: **CaVap 2 (SK)**	**CaPlast Kunststoffverarbeitungs GmbH** **Magdheide, 7** **D-59394 Nordkirchen** NOW CONTEC GMBH & CO. KG Im Gefähr 7 67714 Waldfischbach-Burgalben

Specific product EPD

in accordance with **ISO 14025 and EN 15804:2012+A2:2019/AC:2021**

Program Operator Publisher	EPDItaly, www.epditaly.it EPDItaly
Declaration Number Registration Number	EPDCAPLAST_04_2024_rev.1.0 EPDITALY1451
Release Date Expire date	2026-05-28 2031-05-27

1. General information

Table 1 EPD - basic information table

EPD OWNER	
Addresses of declaration owner	**CaPlast Kunststoffverarbeitungs GmbH** **Magdheide, 7** **D-59394 Nordkirchen**
Name of the person responsible for EPD & LCA Report:	Rayc Wulst Product Manager T: +49 (0) 2599 913 27 | M: +49 (0) 160 724 68 13 www.caplast.de
PROGRAMME OPERATOR EPDItaly	EPDItaly; www.epditaly.it Via Gaetano De Castillia, 10; 20124 – MILANO, Italy Version of EPDItaly regulations 7.1
EPD INFORMATION	
Product name	**CaVap 2 (SK)**
Production sites:	Production: CaPlast Kunststoffverarbeitungs GmbH Magdheide, 7 D-59394 Nordkirchen Confectioning: NOW CONTEC GMBH & CO. KG Im Gefähr 7 67714 Waldfischbach-Burgalben
Summary description and technical information of product(s)	This Environmental Product Declaration (EPD) is valid for air, wind and water barrier membranes. Roof membranes are intended for use as an initial roofing layer for ventilated and non-ventilated inclined roofs,
EPD Type	Product EPD – concerning a specific product by a specific manufacturer, EPD is Cradle to Grave.
Identification of the product CPC Code:	36 Rubber and plastics products 369 Other plastics products **3699** Articles of plastics n.e.c.

VERIFICATION INFORMATION	
Version of standard	**ISO 14025 and EN 15804:2012+A2:2019 AC:2021**
Version of PCR	PCR ICMQ-001/15 rev 4.0; CORE PCR for CONSTRUCTION PRODUCTS AND SERVICES: ICMQ -001; Issue date 02/12/2019; revision 4 (10/11/2025); validity 10/11/2030

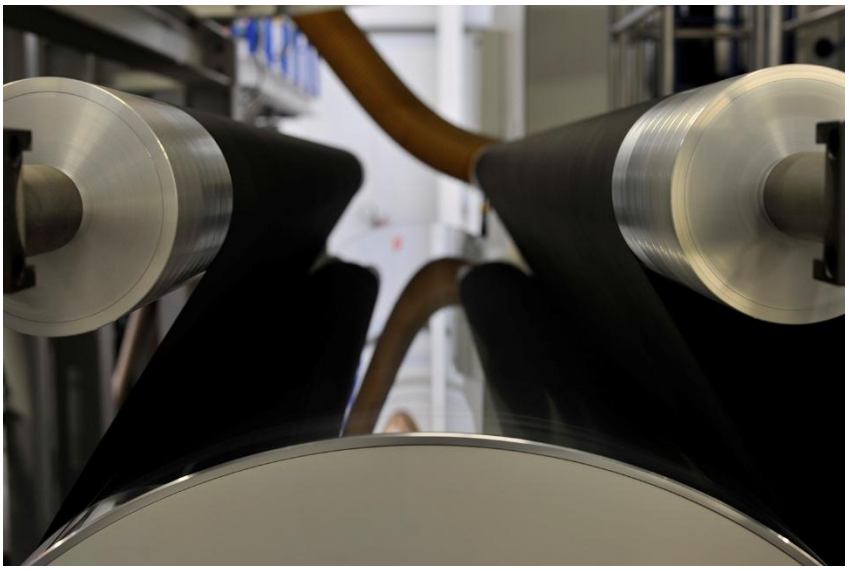
	Technical Guideline to Core PCR ICMQ001 issue date 10/11/2025; rev.0, validity 10/11/2026 EN 15804+A2 AC:2021 is the framework reference for PCRs.
EPDItaly Regulations (version, date of publication or update)	REGULATIONS OF THE EPDItaly PROGRAMME Issue date 05/09/2025; Revision 7.1
LCA Project Report	CaPlast LCA Report - air, wind, vapour and water barrier membranes for roof and façade application
Independent Verification	Independent verification of the declaration and data carried out according to ISO 14025:2010. [ ] Internal [X] External Third-party verification carried out by: SGS ICS Italia Srl; via Caldera, 21, 20153 - Milan T +39 02 73 931 - F +39 02 70 12 46 30 / www.it.sgs.com Accredited by: ACCREDIA; accreditation number: 02242
Statement Comparability	Environmental statements published within the same product category, but from different programmes, may not be comparable. In particular, EPDs of construction products may not be comparable if they do not comply with EN 15804:2012+A2:2019.
Statement Responsibility	The EPD Owner releases EPDItaly from any non-compliance with environmental legislation. The holder of the declaration will be responsible for the information and supporting evidence. EPDItaly accepts no responsibility for the information, data and results provided by the EPD Owner for the life cycle assessment.
FURTHER INFORMATION	
Declared unit	1 square meter (each type of membrane)
Geographical area	Europe / World (raw materials) Germany (Production) Europe (the main sales market), Europe was chosen as the location for End of Life - due to the location of the main customers for the product
Temporary coverage	Reference year 2024
EPD information	This declaration has been developed referring to EPDItaly, following the 'Regolamento di EPDItaly"; further information and the document itself are available at: www.epditaly.it.
Orientation where more information can be found	https://www.caplast.de www.now-contec.de
Comparability	EPDs relating to the same product category but belonging to different programs may not be comparable. EPD for construction products may not be comparable unless it complies with EN 15804
Liability	EPDItaly declines any responsibility regarding the manufacturer's information, data, and results of the life-cycle

	assessment, and also nonconformity of environmental legislation.
LCA Software and data base	SimaPro v 10.2.01 and Ecoinvent database 3.11
Technical support	CRMP Wojciech Piskorski, ul. Ledóchowskich 10, 33-101 Tarnów {PL} Wojciech Piskorski; wojciech.piskorski@carbonium.pl Ryszard Ścigała; ryszard.scigala@carbonium.pl Carbonium Expert Team; www.carbonium.pl

2. Company information

CaPlast GmbH, based in Nordkirchen (Germany), has been operating since 1967. The company acts as a development partner, service provider, and manufacturer of functional film and membrane systems for construction applications and industrial uses.

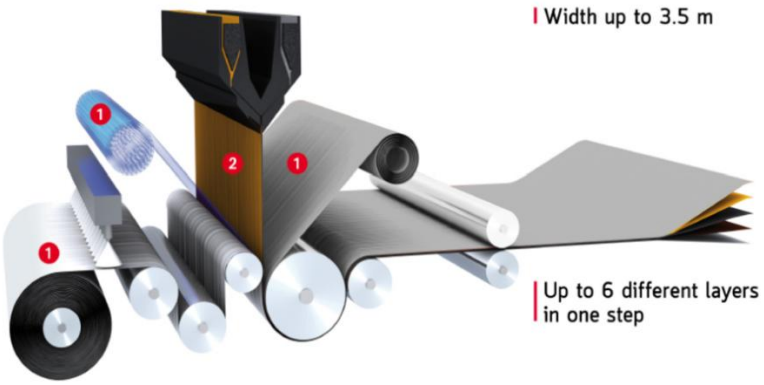
The product portfolio includes vapour barriers, underlay and roof underlay membranes, roof and façade membranes, as well as system accessories such as adhesive tapes, adhesives, and prefabricated components. The products are predominantly developed as customized solutions and distributed via specialist retailers.



CaPlast offers durable, multi-layer membrane systems, including TPU-coated nonwovens that are waterproof, flexible, and weldable. In addition, diffusion-tight vapor barriers made of multi-layer aluminum composites with fabric reinforcement are manufactured for installation in roof and ceiling structures between the load-bearing construction and the thermal insulation. Thanks to modern production facilities, CaPlast can implement customer-specific solutions efficiently and economically. A technologically advanced machine park allows us to produce membranes in compliance with the highest European standards. This is confirmed by numerous certificates that meet the highest criteria.

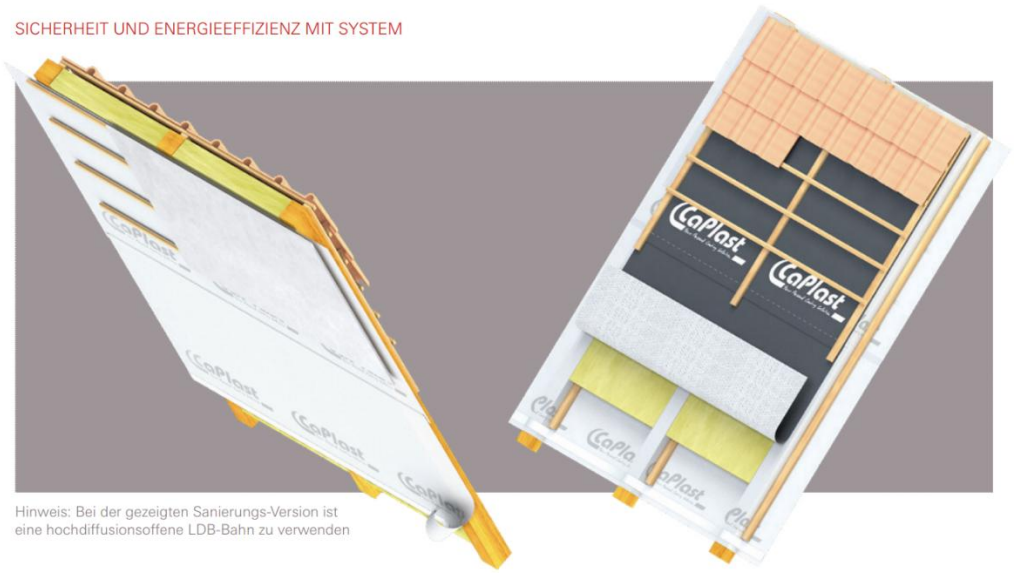
3. Product information

CaPlast develops manufactures, and supplies customized functional films such as vapor barriers, vapor barriers, underlay membranes, roof underlay membranes, and system accessories such as adhesive tapes, cartridge adhesives, and prefabricated corners.



The membrane manufacturing process, from design to distribution, is carried out in accordance with the requirements of management systems in accordance with ISO 9001, 14001, 45001, and the certification of these systems by TÜV Nord is valid until 2026-11-24

CaVap 2 SK is a vapour barrier for diffusion-open roof and wall constructions in mild climate zones. It is particularly suitable for timber and renovation-friendly constructions, where a certain degree of re-drying is permitted. The vapour barrier consists of a polypropylene (PP) non-woven material with a copolymer coating. The membrane is equipped with an integrated self-adhesive strip for assembly assistance. The vapour barrier is also available without self-adhesive strip as CaVap 2.



FIELDS OF APPLICATION
Vapour barrier for internal construction
Vapour barrier for external renovations
Diffusion-open wall and roof constructions
Timber-framed building styles
Renovation work and new constructions

BENEFITS
Virtually universal vapour barrier
Good inherent stability thanks to non-woven reinforcement
Translucent (rafters are visible)
Available with or without self-adhesive strips
Easy and safe to work with, even on complex details

TECHNICAL DATA	EN 13984
Weight (g/m^2)	90 ± 9
Fire behavior	E
Water vapor permeability sd (m)	2 ± 1
Resistance to water penetration	W 1
Resistance to impact load	classified
Maximum tensile strength (L / T) (N / 50 mm)	120 / 110
Elongation at maximum tensile strength (L / T) (%)	80 / 90
Tear resistance (nail shaft) L / T (N)	90 / 90
Shear resistance of joints (N / 50 mm)	50
Roll width/Roll length (m)	1.50/50 3.00/50

A CaPlast membrane typically consists of two layers of thermoplastic nonwoven fabric with a functional film sandwiched between them, responsible for waterproofing and vapor permeability.

All membranes produced consist of a bottom nonwoven, a top nonwoven and a functional film produced beforehand. Depending on the process used, the top nonwoven can be extruded directly before the lamination process or a previously produced nonwoven is used. The bonding of the individual layers can be done by thermal lamination alone or by the addition of powdered or liquid adhesive, and the high temperature accelerates the bonding of the layers. There are no other differences in the manufacturing process of the different types of membranes.

The production of the upper nonwoven fabric is done as follows: thermopolymers, flame retardant, UV stabilizer, and in some cases, color masterbatch (pigment) are loaded into dispensers. The granulate mixture, in the appropriate proportions, is transferred to an intermediate tank and then to an extruder. The granulate mixture is plasticized in a single-screw extruder, after which threads are extruded through screens and dies. The extruded material is then bonded with the functional film and additional nonwoven fabric (the bottom layer, either purchased externally or extruded in a separate process) using heated calenders at the appropriate temperatures. The functional film and the bottom nonwoven fabric are supplied to calenders by a series of unwinders and spreading rollers.

On one line, the product is transported through a printing module. The resulting membrane is cut into the appropriate lengths before being wound onto spools. The obtained Jumbo Rolls are typically transported to the second production facility - Now Contec, where they are further processed into smaller rolls, are properly labelled, additional adhesive strips are applied, and prepared for dispatch according to orders.

The packaging of CaPlast membranes consists of:

- Wooden pallets
- Cardboard
- Cardboard cores
- Paper
- Stretch film
- Strapping tape

All materials used are recyclable and can be reused or disposed of in accordance with local waste disposal regulations.

Production process

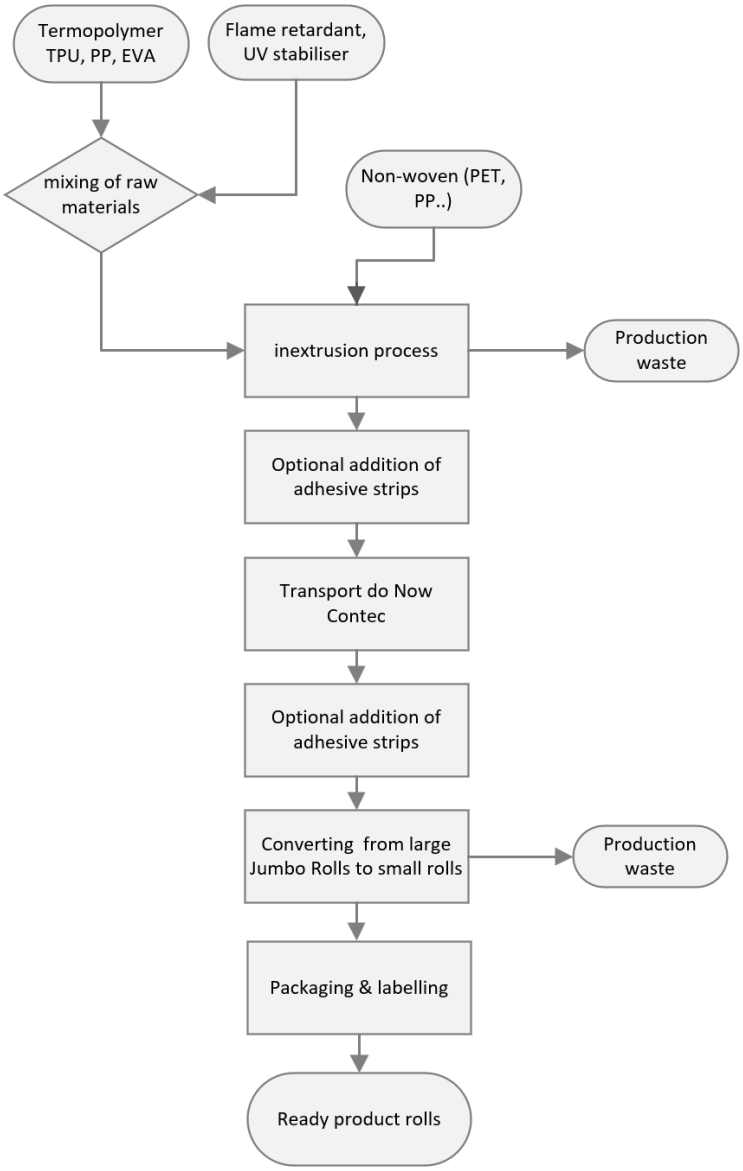


Figure 1 The production flowchart

Main product content

The composition of the membranes covered in this report is as follows:

Table 2 Bill Of Material

				Product content			
Product	**Weight g/m2**	**Declared Unit**	**Conversion factor, m2->kg**	**PP-NV Fabric carier (non-woven) %**	**Thermoplast %**	**Adhesive/ Sealant %**	**Colorants/UV stabiliser /Flame retardands %**
CaVap 2 (SK)	90 +/- 9	1 m^2	11,11	57,5%	31,1%	10,8%	0,6%

Due to the biogenic carbon content of more than 5% by mass in packaging, it is necessary to take this figure into account in the LCA. The assessment of carbon content was based on the types of materials used for packaging. No biogenic carbon was identified in the other materials, in particular the raw materials used

for the membranes. A summary of the materials making up the packaging and the biogenic carbon content is presented below.

Table 3 Bio-carbon content

Material in packaging	Quantity	unit	%	Biocarbon, %
Wood (Holzplatte) (kg)	7,80E-05	kg/m2	11,6%	49,40%
LDPE	1,17E-04	kg/m2	17,3%	0,00%
Cardboard	1,62E-04	kg/m2	24,0%	39,37%
Euro-flat pallet (pcs.)	1,59E-05	pcs/m2	-	-
Euro-flat pallet (kg)	3,18E-04	kg/m2	47,1%	49,40%
Mass of packaging	**0,00068**	kg/m2	-	-
BioCarbon in packaging per square metre of membrane	**0,00026**	kg/m2	-	-
BioCarbon content in packaging	**38,4%**			

The carbon content of cardboard and wood was assessed using data from the Ecoinvent database.

Substances of very high concern (SVHC)

With reference to:

- Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the "Registration, Evaluation, Authorization and Restriction of Chemicals" (REACH), as subsequently amended specifically with:
- Annex XIV of REACH: "List of substances subject to authorization"
- Annex XVII: "List of restricted substances"
- the "Candidate List of Substances of Very High Concern" published by the European Chemicals Agency

according to the information currently available to us, all membranes and related accessories manufactured and distributed by CaPlast do not contain any restricted, prohibited and SVHC substances. They do not release any dangerous substances during the use stage.

4. Life Cycle Assessment Information

Declared Unit

The declared unit is defined as square meter (1 m^2) of membrane. The grammage varies from 80 g/m^2 to 100 g/m^2 depending on the product.

Reference Service Life

Due to the lack of a specific PCR relating strictly to the membranes, the Reference Service Life is not specified, although it can be assumed that their lifetime may be analogous to that of the buildings and structures into which the membranes have been incorporated. It can be assumed that membranes are regarded as having 50 years Reference Service Life (RLS) independent of their material - the same service life as the building.

System and its boundaries

As the boundaries of the system, the Cradle to Grave was adopted.

Table 4 Modules declared

Product stage			Construction stage		Use Stage							End of Life				Benefists & Loads
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport	Installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Energy Use	Water Use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential
X	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X

In Module C1, it is assumed that the membranes are removed manually, resulting in zero environmental impact.

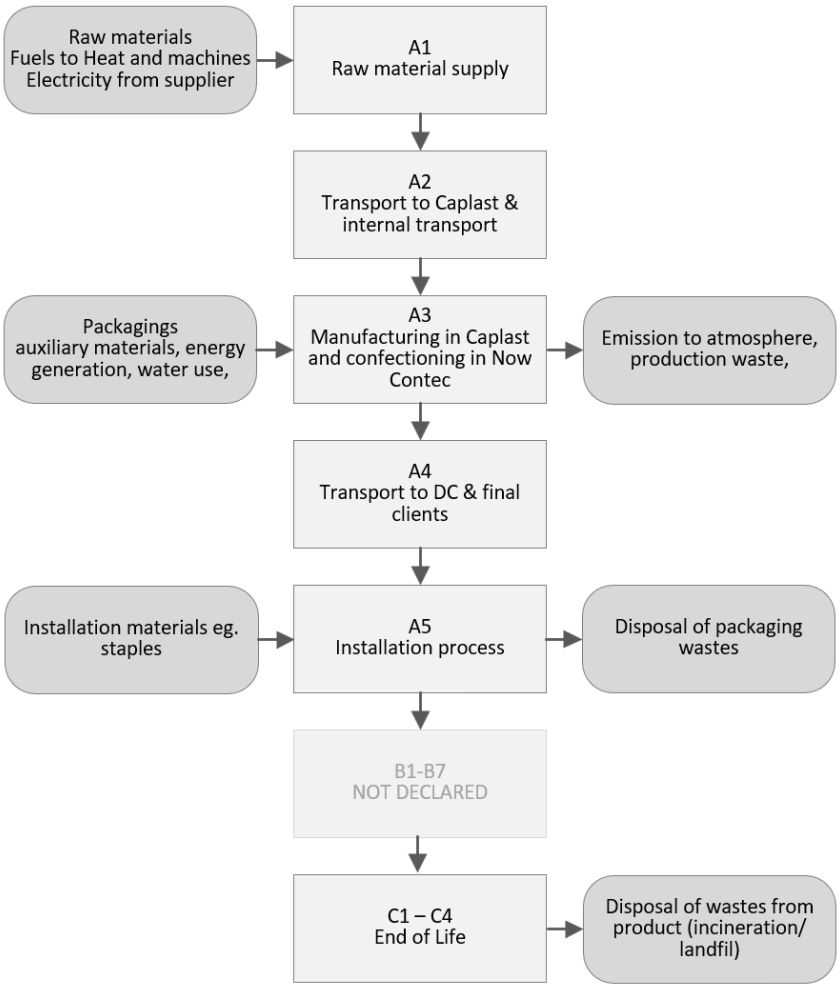


Figure 2 System boundaries

Table 5 LCA modules

Module	Description for Caplast membrane LCA
A1	The calculations used a model for individual raw materials. In particular, the manufacture of plastics and additives necessary for the production of membranes. The Ecoinvent database and SimaPro software were used. In the case of composite materials, e.g. plastic+additives, the calculation separates the material into the basic raw materials according to the percentage of the individual components. The weight of raw materials was based on the gross BOM according to the Caplast accounting and settlement system. The calculations took into account the packaging of incoming raw materials, i.e. their weight and types of materials (bags, octabins, big bags). The generation of electricity not produced by the EPD Owner is included in A1, as also the production of fuels consumed by the EPD Owner for thermal or mechanical energy. Transport processes within the supply chain (excluding transport from direct suppliers) is included in A1 if they are not based on specific data but on average data (usually included in generic datasets). Production of auxiliary materials is not included in A1. Water is included in A1 if it is a constituting and purchased input. The emission factor of the electricity for 2024 was 0,1073 kgCO2e/kWh.
A2	The calculations used a model of transport from sources to manufacturing plant of materials based on actual logistic data from Caplast IT system. A2 includes all transport processes from the direct suppliers, including transport of constituting materials, packaging materials of the product and auxiliary materials of the manufacturing. Internal transport of laminates between the laminate production site and the site of manufacture and final packaging of the end product was also taken into account. Internal transport is included in A2.
A3	The calculations used actual data on consumption of electricity, fuels, water, and took into account only emissions to the environment, internal transport and handling of production waste; this module also includes raw materials for final packaging. A3 includes the upstream production processes in the supply chain of auxiliary materials and product packaging. Additionally, all natural resources directly extracted and all emissions directly generated by manufacturing process is included in A3. Handling of manufacturing waste up to the end-of-waste state (e.g. transport, processing, treatment, disposal) is included in A3.
A4	The transport work was calculated on the basis of actual deliveries to the distribution centers based on logistics data (weighted average), including delivery distances taken from the Caplast billing system (>32 t, EURO 4, RER). Transport between distribution centers and end customers has been adopted based on the European Commission's recommendation [1]. as 100% local: 250 km round trip by van (lorry <7.5 t, EURO 3).
A5	The module considers all membranes installation steps (including auxiliaries production such as staples, holtmelt, tapes) also packaging waste processing (recycling, incineration, disposal). The module also includes the electricity consumption necessary for installation (e.g. welding the edges of the membranes, applying hot-melt adhesive). Credits from potential energy substitution are declared in module D.
B1-B7	ND
C1	The scenario of zero impact was considered. C1 - we assume zero impact because the membrane is a lightweight product that is easy to remove by hand and separate from the rest of the construction materials. There is no need for additional machinery or energy.
C2	considers transportation of the deconstructed membrane to a recycling or disposal process. Distance to disposal site after demolition is assumed to be 100 km

[1] COMMISSION RECOMMENDATION (EU) 2021/2279 of 15 December 2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations

Module	Description for Caplast membrane LCA
C3	The scenario of zero impact was considered; we do not anticipate that used membranes will be specially selected for full energy recovery as secondary fuels. For this reason, in accordance with the standard of section D.3.3 of Module C, it has been assumed that used membranes will be subjected to thermal waste conversion in a plant with a capacity of less than 60%, which is subject to demonstration in Module C4.
C4	module includes all waste disposal processes including pre-treatment and management of the disposal site. It was assumed that the fouled membrane was not recyclable after its useful life and a scenario was envisaged as municipal solid waste incineration – Waste plastic, mixture {Europe without Switzerland}| market group for waste plastic, mixture | EN15804, S.
D	Module D takes into account the potential for energy recovery from modules A5 and C4 (both thermal and electrical energy) in accordance with data on the amount of energy recovered in municipal waste incineration plants (below 60% efficiency). It was assumed that the recovered energy could be replaced by electricity according to the European mix (Electricity high voltage, Europe without Switzerland, market group for electricity; Heat, central or small-scale, natural gas {Europe without Switzerland}| market for heat, central or small-scale, natural gas | EN15804, S). In the case of material recycling (applies to Caliner products, which are mono-material products), it was assumed that the recycling process would produce regranulate in the amount of 80% of the input waste mass.

Assumptions

The list of assumptions are as follows:

The list of assumptions in the LCA study are as follows:

- Module C2: Distance to disposal site after demolition is assumed to be 100 km. In module C, transport of 100 km was used according to COMMISSION RECOMMENDATION (EU) 2021/2279 of 15 December 2021 and also according to verified EPDs of other manufacturers, e.g. declaration number 2021M10140, registration number EPDITALY0140 - Air, wind and water barrier membranes and Vapor control layers - valid to 18/05/2026.
- Due to the fact that the membranes are mainly sold to European customers, it was assumed that the waste scenario record links to ecoinvent incineration and landfill waste treatment processes – the recycling waste treatment processes linked to were created by PRé Sustainability. This datasheet is valid for the municipal solid waste of EU27. Europe without Switzerland incineration and landfill processes were used. Data for European countries were retrieved from the Eurostat table packaging wastes by waste management operation.
- While potential benefits from energy recovery (module A5 and C4) were calculated and European grid mix values were used as a basis (Europe without Switzerland market)
- Assumptions for module A5 regarding the consumption of metal clips and adhesive tape, including the material from which the tape is made. Due to the lack of detailed data on the composition of the tape to be used in the installation of the membranes, non-woven polyester was assumed as the main component of the tape.
- Mass of packaging waste and the waste, dismantled membrane equals the amount of input materials

Cut-off

The cut-off rule was applied to the following input streams, which in terms of factors such as mass; energy requirements and environmental significance are irrelevant for the quantification of environmental impacts. Data excluded from the LCA study due to the cut-off are listed in the table

Table 6 Components and elements excluded from the boundaries of the analysis on a cut-off basis

Process, material	Reason for exclusion		
	Low mass	Negligible energies	Low environmental impact
Module A1: Colorant used in the manufacture of membranes at the fabrication site, as well as membrane additives such as flame retardants, stabilisers, whose mass fraction is negligible and whose composition is unknown or not present in the databases	X	NA	X
Module A3: Waste handling of cardboard, plastic and paint sludge is included in the calculations. The rest of the waste, representing less than 1% by weight, was excluded on a cut-off basis; The A3 module did not take into account thin layers with a thickness of several micrometres, which applied to aluminium and silicone on a polypropylene carrier. Paper labels identifying individual batches and printing ink were also not taken into account due to their negligible quantities (weight and negligible impact on the environment). The cut-off also included auxiliares such as materials used during the maintenance - welding gases, electrodes, lubricants, etc.	X	NA	X
Module A5/C1: Electrical energy consumption during assembly and disassembly of membranes, e.g. for hand-held devices such as drills.	NA	X	X

The check of the cut-off rules was done on the basis of expert judgement based on experience with similar product systems and a partial sensitivity analysis, which assessed how the 'cut-off' input or output affected the final results. For individual products, the sum of the masses of substances that were excluded from the cut-off calculations did not exceed 1%, so it can be assumed that the resulting LCIA calculations are meaningful.

Allocation principles

Since measurements of **electricity, heat, water, fuel consumption and generated waste** are recorded for the entire plant without dividing it by the types of membranes produced, an allocation of the aforementioned utilities by membranes weight was applied.

5. LCA results

Below are tables with the calculation results related to the declared unit, i.e. one square meter (1 m^2), of each membrane. A list of indicators and their descriptions can be found earlier in this paper.

The abbreviations used in the tables refer to parameters describing resource use:

PERE - Use of renewable primary energy excluding renewable primary energy resources used as raw material

PERM - Use of renewable primary energy resources used as raw material

PERT - Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)

PENRE - Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material

PENRM - Use of non-renewable primary energy resources used as raw material

PENRT - Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)

For indicators in the 'Parameters describing resource use' and 'Information describing output flows' groups, the results presented in the individual modules may be derived solely from generic data in the Ecoinvent database, rather than from a direct inventory. In particular SM (secondary material) and RSF (renewable secondary fuels) indicator values were derived from datasets, rather than inventory data.

Table 7. Results CaVap 2 (SK)

Membrane:	CaVap 2											
Impact category	**Unit**	**A1**	**A2**	**A3**	**A1 -A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Climate change	kg CO2 eq	3,86E-01	2,16E-02	2,42E-02	4,32E-01	2,42E-02	1,19E-02	0,00E+00	5,83E-03	0,00E+00	1,41E-01	-1,00E-01
Climate change - Fossil	kg CO2 eq	3,79E-01	2,16E-02	2,24E-02	4,23E-01	2,42E-02	1,09E-02	0,00E+00	5,82E-03	0,00E+00	1,41E-01	-9,86E-02
Climate change - Biogenic	kg CO2 eq	6,46E-03	1,43E-05	1,83E-03	8,31E-03	1,26E-05	1,07E-03	0,00E+00	2,51E-06	0,00E+00	1,14E-05	-1,35E-03
Climate change - Land use and LU change	kg CO2 eq	5,44E-04	7,21E-06	2,13E-06	5,53E-04	8,66E-06	1,06E-05	0,00E+00	2,19E-06	0,00E+00	1,63E-06	-1,21E-04
Ozone depletion	kg CFC11 eq	1,14E-08	4,73E-10	2,39E-11	1,19E-08	5,29E-10	8,89E-11	0,00E+00	1,27E-10	0,00E+00	7,59E-11	-2,98E-09
Acidification	mol H+ eq	1,42E-03	8,81E-05	1,11E-05	1,51E-03	1,15E-04	8,51E-05	0,00E+00	2,23E-05	0,00E+00	4,93E-05	-2,43E-04
Eutrophication, freshwater	kg P eq	9,25E-05	1,48E-06	3,47E-07	9,44E-05	1,85E-06	8,48E-06	0,00E+00	4,80E-07	0,00E+00	5,47E-07	-3,71E-05
Eutrophication, marine	kg N eq	2,98E-04	3,31E-05	4,95E-06	3,36E-04	4,55E-05	1,24E-05	0,00E+00	7,99E-06	0,00E+00	1,22E-04	-5,13E-05
Eutrophication, terrestrial	mol N eq	3,05E-03	3,61E-04	4,58E-05	3,45E-03	4,96E-04	1,28E-04	0,00E+00	8,70E-05	0,00E+00	2,37E-04	-4,73E-04
Photochemical ozone formation	kg NMVOC eq	1,71E-03	1,30E-04	1,45E-05	1,85E-03	1,68E-04	4,14E-05	0,00E+00	3,21E-05	0,00E+00	6,98E-05	-1,93E-04
Resource use, minerals and metals	kg Sb eq	2,08E-06	7,32E-08	3,88E-09	2,16E-06	1,00E-07	5,85E-07	0,00E+00	2,72E-08	0,00E+00	1,07E-08	-1,01E-07
Resource use, fossils	MJ	9,38E+00	3,08E-01	1,86E-02	9,71E+00	3,43E-01	1,27E-01	0,00E+00	8,23E-02	0,00E+00	4,93E-02	-1,86E+00
Water use	m3 depriv.	1,12E-01	1,56E-03	1,39E-03	1,15E-01	1,83E-03	3,43E-03	0,00E+00	4,57E-04	0,00E+00	1,87E-03	-2,18E-02
Additional impact category	**Unit**	**A1**	**A2**	**A3**	**A1 -A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Particulate matter	disease inc.	1,51E-08	1,78E-09	1,06E-10	1,69E-08	1,95E-09	9,64E-10	0,00E+00	3,53E-10	0,00E+00	3,94E-10	-9,89E-02
Ionising radiation	kBq U-235 eq	2,47E-02	3,68E-04	7,23E-05	2,52E-02	5,37E-04	6,86E-04	0,00E+00	1,50E-04	0,00E+00	6,90E-05	0,00E+00
Ecotoxicity, freshwater	CTUe	2,46E+00	4,09E-02	4,30E-02	2,55E+00	5,54E-02	1,14E-01	0,00E+00	1,49E-02	0,00E+00	4,18E-01	-9,33E-10
Human toxicity, cancer	CTUh	8,83E-11	3,71E-12	2,89E-12	9,49E-11	6,76E-12	1,53E-11	0,00E+00	1,08E-12	0,00E+00	4,93E-11	-2,58E-02
Human toxicity, non-cancer	CTUh	2,61E-09	1,93E-10	7,25E-11	2,88E-09	2,37E-10	5,91E-10	0,00E+00	4,97E-11	0,00E+00	6,02E-10	-1,17E-01
Land use	Pt	1,24E+00	1,82E-01	8,74E-02	1,50E+00	1,64E-01	5,72E-02	0,00E+00	3,39E-02	0,00E+00	4,83E-02	-1,75E-11
PARAMETERS DESCRIBING RESOURCE USE	**Unit**	**A1**	**A2**	**A3**	**A1 -A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
PERE	MJ	5,15E-01	5,01E-03	8,23E-03	5,28E-01	6,89E-03	2,28E-02	0,00E+00	1,87E-03	0,00E+00	1,39E-03	-2,06E-01
PERM	MJ	0,00E+00	0,00E+00	7,93E-03	7,93E-03	0,00E+00	-7,93E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	5,15E-01	5,01E-03	1,62E-02	5,36E-01	6,89E-03	1,49E-02	0,00E+00	1,87E-03	0,00E+00	1,39E-03	-2,06E-01
PENRE	MJ	5,76E+00	3,08E-01	1,89E-02	6,09E+00	3,43E-01	1,32E-01	0,00E+00	8,23E-02	0,00E+00	3,67E+00	-1,86E+00
PENRM	MJ	3,62E+00	0,00E+00	-2,39E-04	3,62E+00	0,00E+00	-4,98E-03	0,00E+00	0,00E+00	0,00E+00	-3,62E+00	0,00E+00
PENRT	MJ	9,38E+00	3,08E-01	1,86E-02	9,71E+00	3,43E-01	1,27E-01	0,00E+00	8,23E-02	0,00E+00	4,93E-02	-1,86E+00
Use of secondary material	kg	2,58E-03	1,38E-04	2,66E-05	2,74E-03	1,71E-04	1,18E-03	0,00E+00	4,41E-05	0,00E+00	3,31E-05	-2,35E-04
Use of renewable secondary fuels	MJ, (NCV)	3,42E-04	1,81E-06	1,69E-04	5,13E-04	2,02E-06	3,19E-06	0,00E+00	4,91E-07	0,00E+00	8,91E-07	-9,82E-07
Use of non-renewable secondary fuels	MJ, (NCV)	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Net use of fresh water	m3	2,76E-03	3,86E-05	3,26E-05	2,83E-03	4,57E-05	8,77E-05	0,00E+00	1,15E-05	0,00E+00	4,42E-05	-5,85E-04
INFORMATION DESCRIBING WASTE CATEGORIES	**Unit**	**A1**	**A2**	**A3**	**A1 -A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Hazardous waste disposed (HWD)	kg	2,35E-02	4,41E-04	3,56E-04	2,43E-02	5,11E-04	3,07E-03	0,00E+00	1,27E-04	0,00E+00	2,06E-03	-2,42E-03
Non-hazardous waste disposed (NHWD)	kg	2,28E+00	9,47E-03	1,44E-02	2,30E+00	1,21E-02	7,69E-02	0,00E+00	3,17E-03	0,00E+00	1,58E-01	-1,85E-01
Radioactive waste disposed (RWD)	kg	6,16E-06	9,06E-08	1,81E-08	6,27E-06	1,33E-07	1,73E-07	0,00E+00	3,73E-08	0,00E+00	1,73E-08	-6,63E-06
INFORMATION DESCRIBING OUTPUT FLOWS	**Unit**	**A1**	**A2**	**A3**	**A1 -A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**
Components for re-use (CRU)	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Material for recycling (MFR)	kg	4,51E-04	3,69E-06	4,71E-07	4,55E-04	1,38E-08	3,71E-08	0,00E+00	1,24E-06	0,00E+00	8,80E-07	-9,43E-05
Materials for energy recovery (MER)	kg	3,22E-07	1,96E-08	1,96E-09	3,43E-07	9,49E-05	8,11E-05	0,00E+00	2,12E-09	0,00E+00	5,01E-09	-2,07E-08
Exported electricity energy (EEE)	MJ	4,01E-03	6,05E-05	1,11E-05	4,08E-03	3,83E-04	8,46E-05	0,00E+00	2,72E-05	0,00E+00	8,59E-06	-2,15E-04
Exported thermal energy (ETE)	MJ	2,07E-03	7,43E-05	7,63E-06	2,15E-03	0,00E+00	0,00E+00	0,00E+00	1,39E-04	0,00E+00	1,48E-05	-6,88E-05

Data Quality

The LCA analysis used data that ensures authoritativeness and eliminates bias and uncertainty as much as possible. The best quality data available was used. Data quality was characterized by both quantitative and qualitative aspects.

The characterization of data quality addressed the following issues:

(a) temporal scope: the age of the data and the minimum period over which the data should be collected;

(b) geographic coverage: the geographic area from which unit process data should be collected to meet the purpose of the LCA study;

(c) technology coverage: a specific technology or combination of technologies;

(d) precision: a measure of the variability of each expressed data value (e.g., variance);

To assess the quality of the data, the DQR index was used, understood as an evaluation of the quality criteria of the dataset on the basis of technological, geographic, time-related representativeness and precision. The DQR index was estimated in accordance with the European Commission Recommendation EU 2021/2279 according to the formula.

$$\mathbf{DQR} = \frac{\mathbf{TeR+GeR+TiR+P}}{\mathbf{4}}$$

Where the respective symbols stand for:
TeR - Technological Representativeness
GeR - Geographical Representativeness
TiR - Time-related Representativeness
P – Precision

The table summarizes the indicators and values used to assess data quality

Table 8. Data quality criteria and indicators

DQR Data quality level	DQL Data quality level	Overall DQR	Overall data quality level
1	Excellent	DQR ≤ 1,5	Excellent quality
2	Very Good	1,5 < DQR ≤ 2,0	Very Good quality
3	Good	2,0 <DQR ≤ 3,0	Good quality
4	Fair	3 < DQR ≤ 4,0	Fair quality
5	Poor	DQR > 4	Poor quality

In order to determine the values of the indicators characterising the quality of the data, the descriptive parameter matrix used in SimPro software was used. This matrix coincides with the table presented in Annex E of the ISO 15804+A2:2019/AC:2021 standard, with the exception that it still contains an additional criterion related to the Precision parameter. Quantitative assessment of data quality has been carried out on the basis

of the contribution of the individual footprint components listed below, which together account for 90% of the total footprint.

Table 9. DQR values

Module	Process	Time-related coverage (TeR)	Geographical coverage (GeR)	Technology coverage (TiR)	Precision (P)
A1	Raw material supply	1,25	1,72	2,00	1,94
A2	Transport (product stage)	3,00	1,00	1,00	1,00
A3	Manufacturing	1,40	2,20	1,80	2,00
A4	Transport (Construction stage)	1,00	2,00	2,00	1,00
A5	Installation process	1,33	1,33	2,00	2,00
C2	Transport (End of Life)	1,00	2,00	2,00	1,00
C4	Disposal	2,00	3,00	3,00	3,00
		DQR	1,73	Very good quality	

Additional environmental information

More information on membranes and the environment can be found at:

https://www.caplast.de

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